

## First report of Tischeriidae (Lepidoptera) on the Galapagos Islands, Ecuador, with descriptions of two new endemic species

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**First report of Tischeriidae (Lepidoptera) on the Galapagos Islands, Ecuador, with descriptions of two new endemic species.** - The family Tischeriidae is reported from the Galapagos Islands for the first time. The two species found on the archipelago (*Astrotischeria scalesiaella* B. Landry, sp. n. and *A. alcedoensis* B. Landry, sp. n.) are described and illustrated. Both species are presumed to be endemic and their larvae are leaf miners on *Scalesia* species, a group of endemic Asteraceae.

**Keywords:** Micro moths - *Astrotischeria* - taxonomy - leaf miners - *Scalesia* - Asteraceae.

### INTRODUCTION

The Tischeriidae (Tischerioidea) are a group of small, primitive moths belonging to the Monotrysiinae Heteroneura (Lepidoptera). They may be the sister-group of the Ditrysiinae (Nielsen & Kristensen, 1996; Kristensen & Skalski, 1998) although Davis (1986) presented an alternative hypothesis of relationships. Some 101 species are described so far, mostly from the Holarctic Region, but species are known also from the Ethiopian, Oriental, and Neotropical Regions (Puplesis & Diškus, 2003). Eleven species have been described from the Neotropics, but the region remains poorly known with regard to its leaf-mining fauna. The region with the most diverse tischeriid fauna is the Nearctic, with 48 described species (Davis, 1983). Larvae mine leaves of Fagaceae, Rosaceae, Asteraceae, Rhamnaceae, Malvaceae, and Tiliaceae, in decreasing order of importance, although Anacardiaceae, Apocynaceae, Combretaceae, Ericaceae, Euphorbiaceae, Hypericaceae, Sterculiaceae, and Theaceae are also used (Puplesis & Diškus, 2003).

For the purpose of documenting the micro-moth fauna of the Galapagos archipelago, BL conducted fieldwork on most of the larger islands in 1989 and 1992. Since 1997, LRA and others at the Charles Darwin Research Station on Santa Cruz Island,

did more collecting and reared more immature stages, leading to a wealth of new information. This paper is part of a series begun in 1992 (Landry & Gielis, 1992) to describe new species and report on other native and introduced species of micro-moths in the Galapagos to develop a better understanding of this important group of insects for biodiversity management purposes.

## MATERIAL AND METHODS

Most of the moths studied here were reared from mined leaves of *Scalesia* species (Asteraceae). Mined leaves were collected by staff of the Charles Darwin Research Station (CDRS), Santa Cruz Island, Galapagos, brought to their quarantine lab, and placed in cages. Emerging moths were collected and mounted. Two other series of specimens were available for study. The larger one was collected by BL in 1992 with a portable generator and a mercury-vapour lamp placed in front of a white sheet (see Landry & Gielis, 1992). The other series was collected at light in 1964 and was borrowed from the California Academy of Sciences, San Francisco, California, U.S.A. (CAS).

The holotype and some paratypes of *Astrotischeria scalesiaella* will be deposited in the Muséum d'histoire naturelle, Geneva, Switzerland (MHNG). The other paratypes of *A. scalesiaella* will be deposited in the CAS, CDRS, National Museum of Natural History, Washington, D.C., U.S.A. (USNM), and The Natural History Museum, London, England (BMNH). The single known specimen of *Astrotischeria alcedoensis* is deposited in the MHNG.

The species described here were determined to be new by comparing specimens with the types of seven of the Neotropical species, with the original and more recent descriptions of four species (Bourquin, 1962; Puplesis & Diškus, 2003), and with the treatment of the North American species published by Braun (1972). The types of six Neotropical species described by Meyrick and Walsingham were examined at the BMNH. The type of *Tischeria unicolor* Walsingham is located in the Naturhistorisches Museum Wien, Vienna, Austria (NMW) and was borrowed for examination.

Genitalia were dissected after the abdomen had macerated in a cold 20% KOH solution overnight. The dissected parts were kept in lactic acid stained with orange G for description purposes. They were subsequently stained with chlorazol black and mounted on slides in Euparal. The head of one male specimen was similarly treated. The right pair of wings of one male specimen was removed, bleached, stained with acid fuchsin, and mounted in Euparal.

Illustrations of the adult head and genitalia were made with the AutoMontage® system using a video camera mounted on a Leica MZ APO stereomicroscope or a Zeiss Axioskop compound microscope. The wing venation was drawn using a camera lucida mounted on a compound microscope.

The descriptions and nomenclature of parts are based on Puplesis & Diškus (2003). Generic characters were not repeated. In the legs, wings, thorax, and abdomen only the lateral or dorsal exposed surfaces are described; the ventral or median surfaces of the legs are uniformly whitish beige.

## SYSTEMATIC TREATMENT

*Astrotischeria* Puplesis & Diškus, 2003

The genus was described to include a monophyletic group of species found only in the New World. Thirty species are known, seven of which were described from the Neotropical Region (Argentina, Chile, Ecuador, Peru).

Species of *Astrotischeria* are characterised by the following synapomorphies: presence of a dorsal arm on the valva; shortened uncus with arms (with some exceptions); long, distally bifurcated aedeagus; strongly developed anellus thickened laterally; enlarged vinculum; stronger development of microtrichia on the female tergite IX; slightly reduced, narrowed ovipositor lobes; greatly elongated mediobasal spur of the hind tibia, which is as long as the tibia; and use of Malvaceae and Asteraceae as hostplants (Puplesis & Diškus, 2003).

*Astrotischeria scalesiaella* B. Landry sp. n.

Figs 1-2, 4-7, 9-12

*Holotype* ♂. [1] "ECU., GALAPAGOS/ Santa Cruz, Los/ Gemelos, 27.v.1992/ M[ercury] V[apor] L[amp], leg. B. Landry" (MHNG). Printed in black ink on white paper. [2] "Tischeria/ det. Davis 1993". Hand-written on white card stock with black border in black ink except for black ink printed "det. Davis 19". [3] "HOLOTYPE/ *Astrotischeria/ scalesiaella/* B. Landry". Hand-written in black ink on red card stock. Specimen in perfect condition.

*Paratypes*, Ecuador: 12 ♂♂, 10 ♀♀ from the Galapagos Islands. FLOREANA: 1 ♂ (dissected, slide BL 1175), Cerro Pajas, 26.xii.1998, ex larva en *Scalesia pedunculata* (L. Roque). SANTA CRUZ: 1 ♀, Los Gemelos, 17.i.2002, [no emergence date], Minador de hojas *Scalesia pedunculata* (R. Boada); 1 ♂ (dissected, BL 1415), same data as holotype; 1 ♂, 1 ♀, Los Gemelos, 2.ix.2001, emergio 10.ix.2001, Minador *Scalesia pedunculata* (L. Roque); 2 ♂, 1 ♀, Los Gemelos, 11.ix.2001, emergio 28.ix.2001, 30.ix.2001 and no emergence date, Criada en hojas *Scalesia pedunculata* (R. Boada); 4 ♂, Los Gemelos, xi.1999, [no emergence date], En *Scalesia pedunculata* (T. Poulson); 1 ♂, 2 ♀ (one dissected, BL 1417), Finca Vilema, 2 km W Bella Vista, 1.iv.1992, M[ercury] V[apor] L[amp] (B. Landry); 1 ♂ (dissected, Wings BL 1416; Head BL 1420), E[stacion] C[ientifica] C[harles] D[arwin], 6.iii.1992, U[ltra] V[iolet] L[ight] (B. Landry); 1 ♀, Steve Devine farm, 31.x.1999, [no emergence date], minador de hojas *Scalesia pedunculata* (C. Causton); 1 ♂ (dissected, BL 1418), 3 ♀, Horneman Farm, 220 m, 5.iv.1964 (D.Q. Cavagnaro). WOLF: 1 ♀ (dissected, BL 1419), 7.ii.2002, Minador *Scalesia baurii* (L. Roque, C. Causton).

*Diagnosis*. This species and the next are easily distinguished from other small Galapagos micro-moths with lanceolate wings by virtue of the combination of three characters of the head: 1- the presence of scales on the proboscis, 2- the drooping labial palpi, and 3- the rough vestiture of the vertex. This is a combination of characters found in all Tischeriidae. Gelechioidea have scales on the proboscis as well, and some have lanceolate wings, but their labial palpi are upturned and their vertex is not rough-scaled. *Astrotischeria scalesiaella* can be separated from *A. alcedoensis* by its smaller size (forewing length up to 3.02 mm in *A. scalesiaella* and 4.28 mm in *A. alcedoensis*), more prominent orange colour with more diffuse brown markings, wider, shorter and more angled uncus arms, apically thinner and more pointed dorsal lobes of the valva, and the shorter cucullus. The female of *A. alcedoensis* is unknown.

*Description*. MALE (n=13) (Figs 1, 4, 6, 7, 9-12). Vertex vestiture a mixture of ochre and brown scales, the ochre scales bicoloured with a paler basal half, the brown scales with white on basal half and apex; frons vestiture (Fig. 4) mostly greyish brown,



1



2



3



4



5



6



7



8

shining, with row of white or pale ochre scales laterally and apically; interocular index ( $n=1$ ): 1.76. Antenna  $2/3$  length of forewing ( $n=1$ ); with 20 flagellomeres ( $n=1$ ); scape and slender pecten brown and white, sometimes with some pale ochre scales; with 6 rows of scales on flagellomere I, with 2 rows on other flagellomeres; scales on flagellomeres with brown apex and white basal half; flagellomere I 3X length of flagellomere II; sensillae chaeticae about 1.5X length of flagellomere on flagellomere II, about  $2/3$  length of flagellomere on last one. Haustellum 3X length of labial palpus; scales on both beige, sometimes with brown laterally on labial palpus. Maxillary palpus 3-segmented, scaled only on third segment. Thorax mostly brown with beige-tipped scales, sometimes with ochre scales at tip of tegulae. Foreleg dark brown. Midleg femur dark brown laterally with pale ochre scales on dorsal edge and beige apically; tibia dark brown with beige on dorsal row of long and narrow scales, and apex; first tarsomere with scales dark brown on apical half and white on basal half; tarsomeres I-V mostly beige with apical dark-brown spot. Hind coxa dark brown with apical row of longer beige scales; femur mostly white; tibia dark brown with beige along ventral margin and on ventral and dorsal rows of long and thin scales, with pale ochre apically; tarsomeres dark brown. Forewing length: 2.46-3.02 mm (holotype: 2.81 mm). Venation (Fig. 9) with only Sc, R, Rs1, Rs4, M1, CuA, and 1A + 2A clearly defined; with a faint indication of Rs3; 1A + 2A not forked at base. Length/largest width: 0.25. With a patch of microtrichia in anal sector. Colour (Fig. 1) mostly dark brown with ochre scales along dorsal margin beyond middle, along cubital fold, in apical sector, and as a diagonal bar or large spot medially, with darker brown markings as two oblique bands before and beyond middle, first one more inclined than second; sometimes with more ochre scaling (fig. 2); sometimes mostly dark brown with a few ochre scales mostly in apical sector; scales paler on their basal half, white on those with dark-brown apical half; fringe greyish brown. Hindwing venation only with Sc + R and A clearly visible. Sockets of the fringe scales forming spines especially conspicuous on costal margin. Without microtrichia. Colour brownish grey, with concolorous fringe. Abdomen greyish brown.

Male genitalia ( $n=3$ ) (Figs 7, 10-12). Socii short, with short, slender setae. Uncus arms separate and connecting to tegumen at their most dorsal and most anterior points; each arm elongate, larger in middle, directed downward, flattened and narrowly rounded at apex, with a few short setae on dorsal and ventral edges beyond connection with tegumen. Tegumen hood-like, rounded dorsally and apically, with short setae dorsolaterally, with very narrow and strongly melanised anterior arms connecting with vinculum, with broader and lightly melanised posterior arms connecting with membranous ventral wall of tegumen. Vinculum rather broad, triangular in ventral view, without saccus. Anellus broad, lightly melanised, rectangular, with about five short

## FIGS 1-8

Galapagos *Astrotischeria* spp. 1. Holotype of *A. scalesiaella*; 2. Female paratype of *A. scalesiaella* from Santa Cruz, Finca Vilema; 3. Holotype of *A. alcedoensis* from Isabela, Volcan Alcedo, reared from *Scalesia affinis*; 4. Head of male paratype of *A. scalesiaella* from type locality; 5. Leaf of *S. pedunculata* mined by *A. scalesiaella* on Los Gemelos, Santa Cruz; 6. Descaled head of male paratype of *A. scalesiaella* from Santa Cruz, Charles Darwin Station; 7. Male genitalia of paratype of *A. scalesiaella* from Floreana, Cerro Pajas, reared from *Scalesia pedunculata*; 8. Male genitalia of holotype of *A. alcedoensis*.

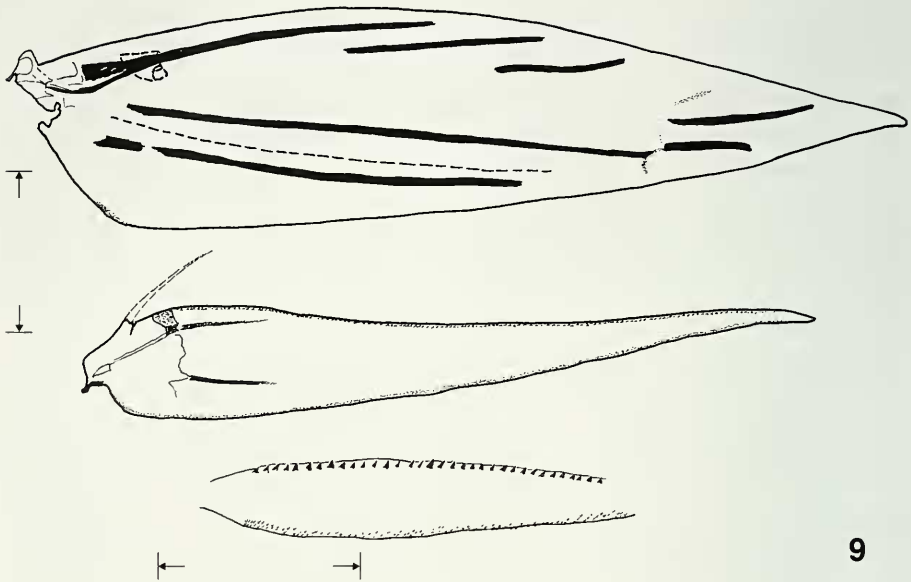
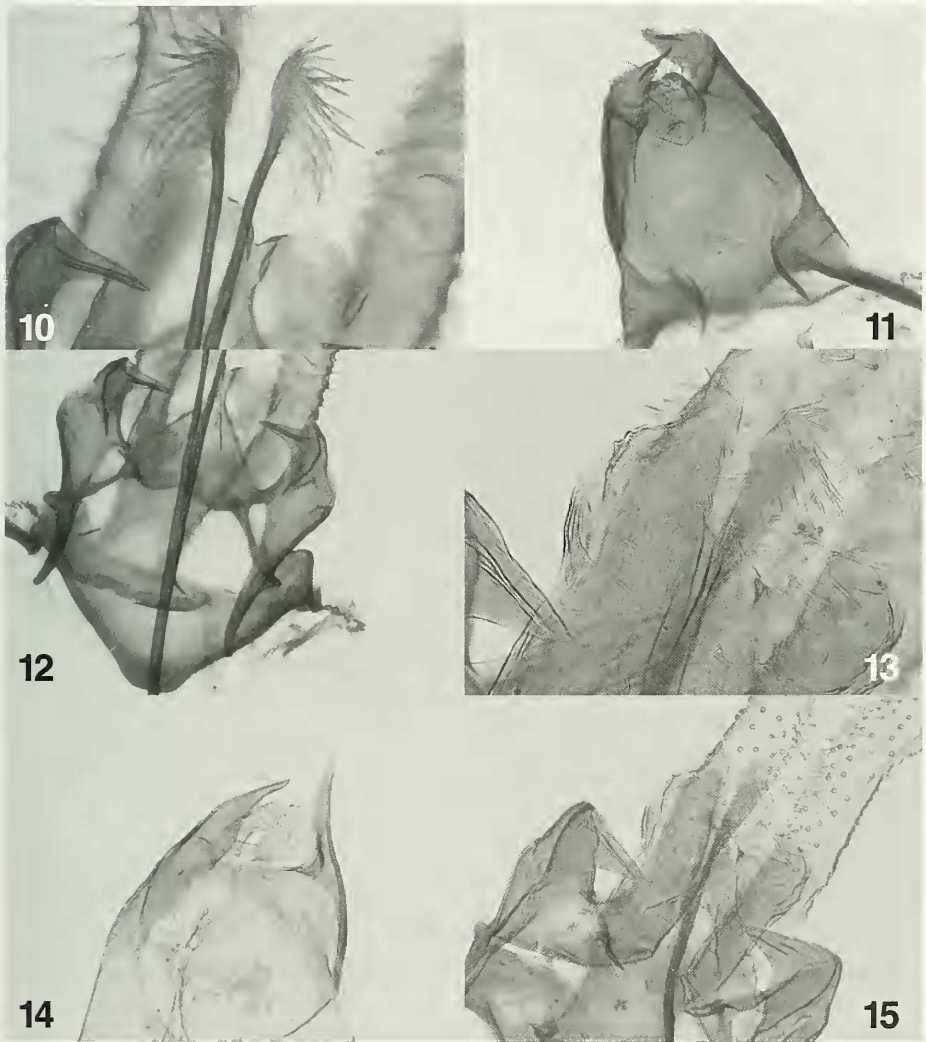


FIG. 9

Wings of paratype male of *Astrotischeria scalesiaella* from Santa Cruz, Charles Darwin Station (frenulum broken) (scale: 0.5 mm) with details of the bases of the costal and inner margins (scale: 0.25 mm).

setae ventrally. Valva with dorsal arm curved inward at right angle, narrowing, apically pointed, and with narrow apodemes projecting directly anteriorly; cucullus slender, slightly curving upward toward apex, with abundant short setation medially, apically not narrowing and rounded, about as long (1.06 X) as dorsal arm inclusive of apodeme. Aedeagus very narrow, slightly longer than vinculum + valva, divided in two divergent branches from about 2/3; each branch apically flattened and with bunch of slender spines and spinules; gonopore from about base of divergent branches.

**FEMALE** (n=10). Antenna 0.62 length of forewing (n=1). Forewing length: 2.58-2.83 mm. Frenulum with two acanthae. Forewing length/largest width: 0.25. Female genitalia (n=2) (Figs 16-21). Ovipositor lobes short and round, with rather stout and slightly curved peg setae, the most medially located ones apically bifurcated; median ridge between ovipositor lobes with a series of three pairs of short setae. Tergum IX a more or less triangular plate, slightly convex, with convex lateral margins, emarginated anterior margin, and straight posterior margin, the latter membranous and set with bunch of 3-4 setae on each side of middle, including one much longer than others; with strongly melanised narrow band at anterior and anterolateral margins connecting lateroanteriorly with bases of posterior apophyses; with long and sparse setation dorsally. Posterior lobes of sternum IX somewhat conical, slightly larger than ovipositor lobes, with short and long setae, with long, straight and apically narrow posterior apophyses extending beyond middle of segment VII; anterior lobes of sternum IX very narrow with short setae directed posteriorly; with two pairs of apo-



FIGS 10-15

Male genitalia of *Astrotischeria* spp. 10-12. Paratype of *A. scalesiaella*, same specimen as fig. 7: 10. Posterior end of aedeagus; 11. Tegumen, uncus, and socii; 12. Dorsal arms of valvae, vinculum, anellus. 13-15. Holotype of *A. alcedoensis*: 13. Posterior end of aedeagus; 14. Posterior end of tegumen, uncus, and socii; 15. Dorsal arms of valva.

physes in membranous area anterior to oviporus: dorsal pair narrow, almost reaching as far as posterior apophyses (of sternum IX), apically acute; ventral pair broader, shorter, reaching slightly beyond anterior margin of sternum VIII. Tergum VIII a narrow rectangular and flat plate slightly broader posteriorly, with one anterolateral projection on each side directed ventrally and connected to anterior apophyses of sternum VIII slightly posterad to their middle. Sternum VIII a rather large concave plate extended laterally, with broadly rounded apical margin set with narrow spinelike

projections. Ductus bursae with small elliptical plate set at right angle in bend beyond anterior end of shorter apophyses of sternum IX, also with thin spinelike scobination anteriorly from bend and until connection with corpus bursae, but more concentrated near tips of longer apophyses. Corpus bursae small and oblong, with tiny spinules on anterior half. Apex of tergum VII medially with joining pair of median arcs of closely set scale sockets with elongate narrow scales. Sternum VII terminating in small wider than long median lobe set with abundant and rather long setation.

*Etymology.* The specific epithet refers to the generic name of the host plants.

*Biology.* Adults were reared from leaf mines found on two species of *Scalesia* (Asteraceae): *S. baurii* Robins. & Greenm. and *S. pedunculata* Hook. filius.

*Distribution.* Endemic to the Galapagos; found on Floreana, Santa Cruz, and Wolf.

*Remarks.* In the female genitalia, my interpretation of tergum IX, which I believe is dorsal, between terga VIII and X, differs from that of Davis (1998) and Puplesis and Diškus (2003), who mention that it is ventral from the lobes of tergum X. In my view, tergum IX of these authors is actually sternum IX because of its position. In Davis' (1998, fig. 6.8 N) schematic drawing of the female genitalia of *Tischeria* (now *Coptotriche*) *citripennella* (Clemens), there is no sclerite between tergum VIII and the ovipositor lobes of tergum X as in *Astrotischeria scalesiaella* (see Figs 18, 19).

*Astrotischeria alcedoensis* B. Landry sp. n.

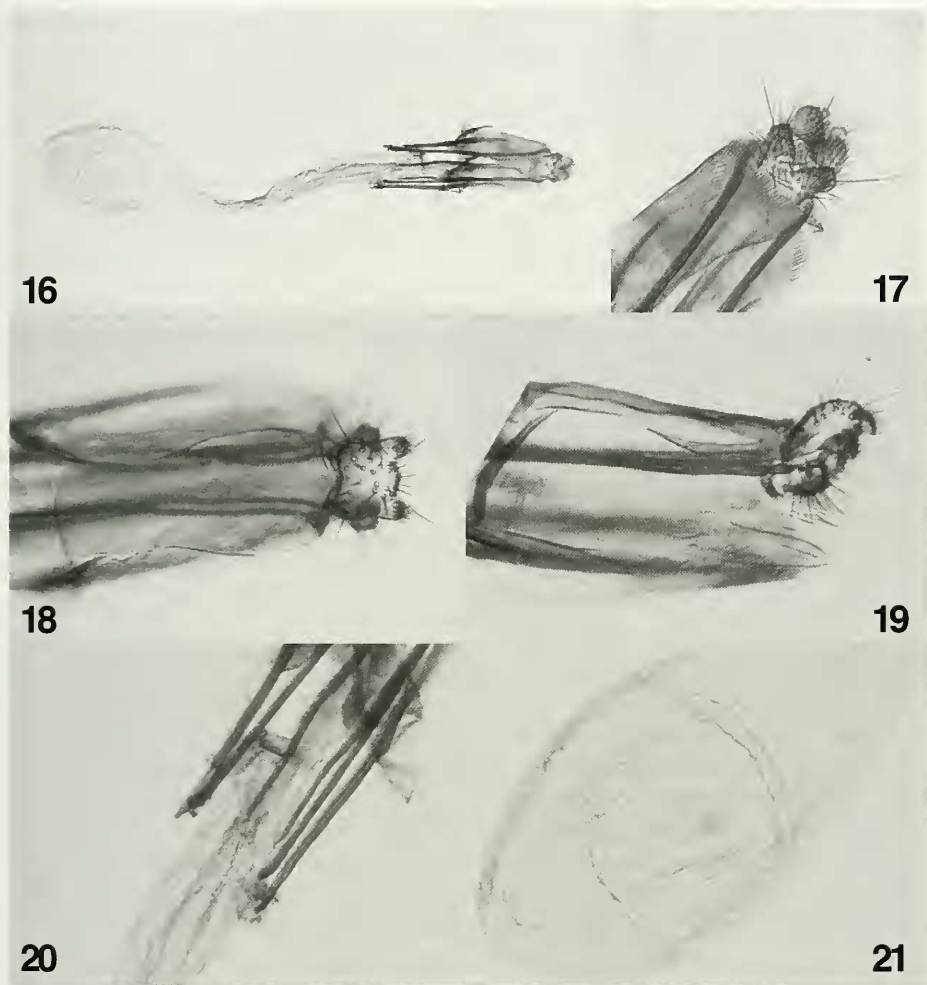
Figs 3, 8, 13-15

*Holotype* ♂. [1] "ECU. GALAPAGOS/ Isabela, V[olcan]. Alcedo, en/ *Scalesia villosa* affinis, 19 X/ 1999, emergio 29 X 1999/ L. Roque" (MHNG). Computer made in black on white paper with black borders on top and bottom. Hostplant species name crossed with pencil and new name added with pencil on last line with an arrow between the two names. [2] "MHNG/ Prép. micr./ No 2724 ♂". Printed black on white card stock except for ink hand written "MHNG", number and male sign. [3] "BL 1423 ♂". Hand-written in black ink on green paper; upside down. [4] "HOLOTYPE/ *Astrotischeria/ alcedoensis/ B. Landry*". Hand-written in black ink on red card stock. The right midleg and hindleg are in a gelatine capsule attached to the pin. The left hindleg is broken beyond the tibia.

*Diagnosis.* See Diagnosis of *Astrotischeria scalesiaella* above to distinguish the two species from each other and from all other known micro-moths of the Galapagos.

*Description.* MALE (n=1) (Figs 3, 8, 13-15). Vertex vestiture with erect scales usually tricolored, pale beige at their base, brown subapically, pale beige at their apex, with a few scales apically shining greyish brown, with appressed scales between antennal bases entirely pale beige; frons vestiture with shorter scales coloured as erect scales of vertex, but scales slightly paler at their base; interocular index not calculated. Antenna about 3/4 length of forewing; approximately 26 flagellomeres (head not mounted on slide); scape brown and white, with greenish-beige narrow pecten; flagellomere I with longitudinal rows of white and brown scales; other flagellomeres with basal scales pale beige and apical scales brown. Haustellum white and brown. Labial palpus dark brown laterally with white apex, pale beige medially. Maxillary palpus scaling probably white (not clearly visible). Thorax mostly with tricolored scales, dirty white at their base, brown subapically, ochre apically. Foreleg coxa with scales bicoloured dirty white at their base and brown at their apex (sometimes with apex a little paler beyond brown area), other parts dark brown except for pale beige





FIGS 16-21

Female genitalia of *Astrotischeria scalesiaella*. 16-17. Paratype from Wolf, reared from *Scalesia baurii*: 16. Segments VIII-X and genitalia; 17. Apex of abdomen. 18-19. Paratype from Santa Cruz reared from *Scalesia pedunculata*: 18. Dorsal view of segments VIII-X; 19. Lateral view of same segments. 20-21. Same specimen as on figs 16-17: 20. Section of ductus bursae; 21. Corpus bursae.

bases of tarsomeres II-IV and all of tarsomere V. Midleg as in foreleg except scales more bicoloured as on coxa and tarsomeres more pale beige except for small patch of brown at apex of tarsomeres II-IV. Hindleg apparently as in midleg, but damaged. Forewing length: 4.28 mm (holotype). Venation not studied. Colour a mixture of beige, brown, and ochre scales, the latter not present in the radial sector, the brown scales usually tricolored with white at base, brown on apical half and beige at apex as a narrow band; without strongly marked pattern in unique and somewhat damaged specimen, but possibly with submedian and postmedian oblique bands as in *A. scale-*

*siaella*; fringe pale greyish ochre. Hindwing venation not studied; colour pale greyish beige; fringe pale greyish ochre. Abdomen colour not recorded.

Male genitalia (n=1) (Figs 8, 13-15). Socii and uncus as in *A. scalesiaella* except arms of uncus more slender, slightly longer, less curved, and narrower apically. Tegumen as in *A. scalesiaella* except slightly broader and with broader posterior arms. Vinculum narrower, less triangular, than in *A. scalesiaella*. Anellus as in *A. scalesiaella* except for apparent absence of ventral setae. Dorsal arm of valva with distal half broader and not as narrowly pointed apically as in *A. scalesiaella*; cucullus as in *A. scalesiaella* except more distinctly bent at about 2/3 and longer, 1.44 X as long as dorsal arm inclusive of apodeme. Aedeagus as in *A. scalesiaella* except broadly curved (possibly an artefact) and base of two apical branches at about 4/5 length; gonopore not observed.

FEMALE. Unknown.

*Etymology*. The specific epithet refers to the collecting locality, Volcan Alcedo, on Isabela Island.

*Biology*. The unique specimen was reared from a leaf of *Scalesia affinis* Hook. filius (Asteraceae).

*Distribution*. Galapagos endemic; found on Isabela, Volcan Alcedo.

*Remarks*. The poorly melanised spines of the apical end of the aedeagus (Fig. 13) may be the result of a premature death.

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